

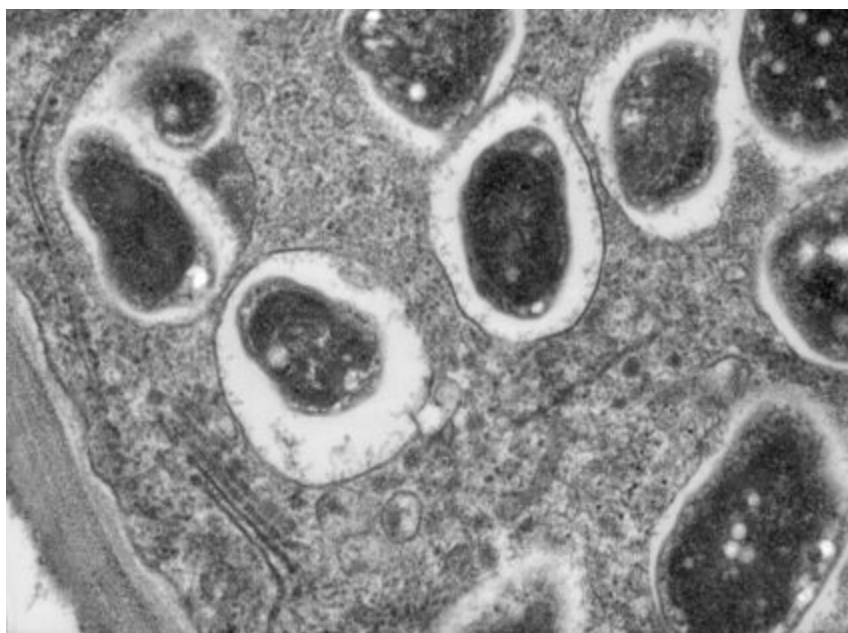
Shelton-Mason County Journal - Dedicated to the citizens of Mason County, Washington since 1886

Get right with nitrogen

Peninsula Permaculture · December 2, 2021



By Alex Féthière



The *Bradyrhizobium japonicum* bacteroids inside this soybean root-nodule symbiosome are capable of fracturing atmospheric nitrogen into plant-available atoms. (*Public domain*)

I have written a lot about nitrogen and its production in and out of the soil. My knowledge is always expanding because it's only recently that humanity has been rethinking how we make and apply this key nutrient.

Recall that the Haber-Bosch Process makes atmospheric nitrogen that is available to plants via a chemical reaction using a fuel feedstock such as natural gas. This industrial process is neither efficient nor benevolent, but provides great short-term returns on poor land in which the soil food web has been sundered.

Nitrogen-fixing is another popular facet of the discussion: the use of soil bacteria that colonize the roots of several types of plant to provide nitrogen to crops. This can serve as a perpetual source of the nutrient, but has to be managed with more care than scattering fertilizer requires.

In my recent studies of the soil food web, I have found nitrogen fixation to be more complex than commonly represented - a portrayal in which I have taken part. It's often said that simply raising nitrogen-fixing plants is enough, but the devil is in the details.

Plants that can host nitrogen-fixing bacteria (e.g., *Frankia*, *Rhizobia*) have infection sites along their root hairs. The correct type of bacteria can colonize these sites and turn root hairs into nodules, which are swollen lumps of tissue that host expanding communities of the bacteria.

"Free-living" bacteria such as *Anabaena* also exist, however. They can form dense colonies in the root zones of plants, but do not inhabit the tissues of their symbionts.

In both cases, the plants use root exudates to actively invite and encourage the bacteria to remain. By supplying them with photosynthetic foods on tap, plants hope that the microorganisms will eventually yield a surplus of nitrogen after their own needs are met.

Although anaerobic (oxygen-free) conditions are undesirable in most processes contributing to fertility, this environment is what one finds at the center of a nitrogen-fixing nodule or free-living colony. Dense habitations become anaerobic at the middle and allow the bacteria to express different genes to survive there.

These genes are also key to producing enzymes for splitting atmospheric nitrogen into two separate nitrogen atoms. These are then bonded to carbon chains to make amino acids, which the bacterial collective uses for their own nourishment until they have enough to release to the plant.

As if this discovery that anaerobic conditions are at the heart of nitrogen fixation weren't enough, I learned that not all *Rhizobia* will form nitrogen-fixing communities with host plants.

We plant peas, vetch, alfalfa and the like that have been inoculated with *Rhizobia*, the name of which means "root-living." How do we know that the species selected by the seed supplier are serving our plants? There are, after all, 98 species in 13 genera.

The only test that doesn't involve a microscope involves inspection and surgery. Inoculated plants are allowed to mature to the point where they exhibit root nodules.

Dig some up and examine them. Are they large and pink on the outside? When cut open, are they red inside as if bloody?

The hemoglobin-like molecule that shows active nitrogen fixation means your *Rhizobia* are creating a surplus that feeds your plant. Lack of these features means they're freeloaders, infecting your plant on bad faith.

Something about local soil conditions is preventing their nitrogen fixation. They're still happy to occupy your plant and chow down on its exudates.

Researchers call these "sneaky" bacteria. I've requested a study about this happening in Scotch broom around Puget Sound.

You can remedy this parasitic relationship by culturing your own *Rhizobium* from locally harvested nodules, and inoculating your plants therewith. Maybe an enterprising reader can provide me with nodules between when I start microscope work and springtime.

Originally published in the Shelton-Mason County Journal, December 2, 2021: <https://www.masoncounty.com/story/2021/12/02/news/get-right-with-nitrogen/470.html>

Text from the Internet Archive copy captured December 6, 2021: <https://web.archive.org/web/20211206022149/https://www.masoncounty.com/story/2021/12/02/news/get-right-with-nitrogen/470.html>